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AUTHOR Holcombe-Ligon, Ariane
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ABSTRACT

Four preschool children with developmental delays were taught to name the numerical value of sets of geometric figures, the corresponding numeral, the corresponding number word, and the corresponding Roman numeral. Half of the stimuli were taught with instructive feedback and the other half without, as two conditions were established: the future condition which included the presentation of future-targeted behaviors during the consequent events for correct responses (i.e., the use of instructive feedback), and the nonfuture condition, which did not include instructive feedback. For example, when numerals were taught directly, instructive feedback (in the form of embedding number words in feedback) was used with half of the numerals but not with the other half. Results indicate that: (1) constant time delay resulted in three of the four children learning to name the numerical value of sets of geometric figures, the corresponding numeral, and the corresponding number word; (2) presentation of instructive feedback in the future condition did not interfere with the acquisition of target behaviors; (3) addition of instructive feedback in the consequent event resulted in more rapid acquisition of those behaviors when they were subsequently instructed. (Contains 16 references.) (CR)

Effects of Instructive Feedback on Future Learning

Ariane Holcombe-Ligon, Mark Wolery, Margaret Gessler Werts
Allegheny-Singer Research Institute

Patricia Hrenkevich, B.S.
St. Peter's Child Development Center
Pittsburgh, Pennsylvania

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Abstract

This study evaluated the effects of presenting instructive feedback for current target behaviors when teaching preschoolers in dyads to name four stimulus variations: (a) the numerical value of sets of geometric figures, (b) the corresponding numeral, (c) the corresponding number word, and (d) the corresponding Roman numeral. Selected behaviors for each of the four types of stimuli were divided into two sets and instructed with a 3-second constant time delay procedure. During instruction, correct responses to one set of behaviors received a token, verbal praise, and presentation and verbal description of the future target stimuli for the currently instructed stimuli in one daily session. In the other daily session, the second set of stimuli received only tokens and verbal praise. After criterion was met on naming the numerical value of sets of geometric figures, children received instruction on naming numerals, followed by instruction on naming number words. A parallel treatments design (Gast & Wolery, 1988) was used to compare the effectiveness and efficiency of the two conditions. Results indicate that: (a) three of the four children learned all future behaviors, (b) presentation of instructive feedback did not interfere with learning, and (c) in terms of direct instruction time required by the teacher, future behaviors were acquired more efficiently.

A substantial portion of the curriculum for individuals with disabilities involves teaching new forms (behaviors) to fulfill functions currently performed by less advanced behaviors (Carr, 1988). For example, teaching a child to request a drink may begin with a non-verbal signal (e.g., a point), move to one-word statements (e.g., some variant of "water"), move to two-word statements (e.g., "Want water."), and eventually move to embedding the request in various sentences (e.g., "May I have some water?" "Please give me some water" etc.). Each variation of the response fulfills the same function (i.e., a request for water). Other portions of the curriculum involve teaching children to use the same form (behavior) to respond to a variety of different stimuli or variations of those stimuli in different contexts. For example, labeling the family canine as a "dog," labeling other dogs as "dogs," labeling photographs of dogs as "dogs," and labeling pictures and line drawings of dogs as "dogs." In both cases, the curriculum is thought to be sequential; that is, some skills are taught first and then the responses are changed over time to be more complex and varied, or the responses are applied to progressively different stimulus variations.

Several strategies have been proposed for teaching students to apply the same response to different but equivalent stimulus variations. These include using multiple exemplars (Stokes & Baer, 1977), using general case programming (Albin & Horner, 1988), and systematically organizing teaching to promote and ensure generalization (Haring, 1988). Another strategy that has shown promise in teaching children to apply the same response to different stimulus formats and variations is instructive feedback (Wolery, Ault, & Doyle, 1992). Instructive feedback involves presenting additional stimuli (or various forms of the stimulus) during the consequent events for correct responses. Operationally, these trials occur as follows: The teacher secures the student's attention, presents the target stimulus and task direction, and provides a response interval. If the student responds correctly, the teacher reinforces the student and presents a second stimulus (or some stimulus variation). Students are not expected to respond to this second stimulus and are not reinforced if they do.

Studies of instructive feedback have shown that simply the presentation of additional stimuli in the consequent events will result in students acquiring some of those stimuli without direct instruction in the traditional sense (Gast, Doyle, Wolery, Ault, & Baklarz, 1991). For example, it has been used to teach students to spell sight words that they are taught to read (Gast et al., 1991), to classify stimuli on some conceptual dimension (Wolery, Holcombe, Werts, & Cipolloni, in press), to define words that they are taught to read (Shelton, Gast, Wolery, & Winterling, 1991), and to state additional factual information related to the response being taught directly (Wolery, Cybriwsky, Gast, & Boyle-Gast, 1991).

Two recent investigations have suggested that the use of instructive feedback may increase the rapidity with which skills are learned when they are later taught directly. Wolery, Doyle, et al. (1991) used progressive time delay in a one-to-one arrangement to teach elementary-aged students with moderate mental retardation to name two sets of

photographs. In one set, the students were simply taught to name the photograph and the consequence for correct naming was praise. For the second set of photographs, the consequences involved praise and presentation of a written word for the object depicted in the photograph (i.e., instructive feedback). After students met criterion on both sets of photographs, the children were taught to read the words of the objects depicted in both sets. The results indicated that the use of instructive feedback (showing the written word during photograph training) resulted in more rapid learning when the students were taught to read the words directly.

In a similar study, Holcombe, Wolery, Werts, and Hrenkevich (1992) taught preschool children in a small group arrangement with constant time delay to label two sets of numerals. In one condition, the consequent events were praise and tokens. In the second condition, instructive-feedback condition, the consequent events were praise, tokens, and presentation of the number word that corresponded to the numeral being taught directly. After children met criterion on both sets of numerals, they were taught directly to read the number words that corresponded to the numerals. Again, the results indicated that the number words that had been presented through instructive feedback were learned more rapidly than those that had not been presented (i.e., they required 18% less instructional time to meet criterion).

In both of these studies (Holcombe et al., 1992; Wolery, Doyle, et al., 1991), an adapted alternating treatment design (Sindelar, Rosenberg, & Wilson, 1985) was used. This design is limited by the fact that only one opportunity existed to evaluate the effects of the instructive feedback. However, given the savings of instructional time found in these studies, the question becomes: "What effects would occur if students experienced instructive feedback on multiple sets of sequentially taught behaviors?" The current investigation was designed to answer this question. Students were measured on their ability to name four stimulus variations: (a) the numerical value of sets of geometric figures, (b) the corresponding numeral, (c) the corresponding number word, and (d) the corresponding Roman numeral. Half of each stimulus variation (e.g., half of the sets) were taught with instructive feedback (i.e., embedding the corresponding numeral in the consequent events for correct responses to number sets), and the other half was taught without instructive feedback. Further, when numerals were taught directly, instructive feedback (embedding number words in the consequent events for correct responses) was used with half of the numerals but not with the other half. Similarly, when number words were taught directly, instructive feedback (embedding Roman numerals in the consequent events for correct responses) was used with half of the number words but not with the other half. We evaluated the effects of these arrangements on the number of children who met criterion on each group of behaviors taught, and the efficiency of that instruction (i.e., number of sessions, number of minutes of instruction, and number and percent of errors to criterion).

Methods

Participants

Four preschoolers attending a half-day preschool program for children with

developmental delays participated in this study. All children had no previous experience with direct instructional procedures. The four children were divided into two dyads for instruction. Children's diagnoses, chronological ages, developmental age scores, and instructional groups are presented in Table 1.

Insert Table 1 about here

To be selected as a participant in this study, children had to demonstrate the following prerequisite skills: (a) ability to attend to auditory and visual stimuli, (b) ability to wait 4 seconds for a prompt, (c) ability to sit and attend to a teacher in the presence of one other child for a minimum of 8 minutes, (d) ability to imitate a verbal model within 3 seconds of the prompt being given, and (e) ability to match to sample unknown behaviors.

Following the selection of participants based upon the prerequisite skills, behaviors were screened to identify unknown behaviors. Screening included assessment of children's ability to (a) rote count, (b) expressively identify the number of members in sets, (c) expressively identify numerals, (d) expressively identify number words, (e) expressively identify Roman numerals, (f) match to sample sets, (g) match to sample numerals, (h) match to sample number words, (i) match to sample Roman numerals, and (j) receptively identify Roman numerals. Behaviors were selected as targets when (a) receptive identification of Roman numerals was less than 25% correct; (b) expressive identification of sets, numerals, number words, and Roman numerals was 0% correct; and (c) match to sample of sets, numerals, number word, and Roman numerals was 100% correct.

Instructional Setting and Arrangements

All experimental sessions occurred in the children's classroom at a table designated for small group activities. The students sat facing a wall and the teacher sat directly across from them facing the classroom. Target probes and instructional sessions were conducted by the classroom teacher. Observational probes were conducted by a research associate. All probes were conducted in a 1:1 arrangement. Instructional sessions were conducted in dyads.

Materials and Equipment

Target stimuli were displayed on white index cards (10 mm x 15 mm) with the target behavior written in black ink on the front of the card. Stimuli in the future condition had the future targeted stimuli printed in black ink on the back of the card. Stimuli are presented by child and instructional condition in Table 1. Laminated index cards with circles drawn on them served as token cards. For each correct answer, the teacher drew an "x" in one of the circles. If each circle on the token card was filled at the end of the session, the card could be traded for the student's choice of a small tangible. A stopwatch was used to time the length of experimental sessions.

Experimental Design

A parallel treatments design (Gast & Wolery, 1988) across behaviors and replicated across subjects was employed to assess the effectiveness and the efficiency of presenting future targeted behaviors as instructive feedback during current instruction. The following sequence was used: (a) Probe I: assess all future and nonfuture target and observational behaviors, (b) Instruction Pair I: train sets in two alternating daily sessions (future and nonfuture), (c) Probe II: probe all future and nonfuture target and observational behaviors, (d) Instruction Pair II: train numerals in two alternating daily sessions (future and nonfuture), (e) Probe III: probe all future and nonfuture target and observational behaviors, (f) Instruction Pair III: train number words in two alternating daily sessions (future and nonfuture), and (g) Probe IV: probe all future and nonfuture target and observational behaviors.

Procedures

General procedures. Initially, students were screened to identify unknown sets, and corresponding numerals, number words, and Roman numerals. Four sets and corresponding numerals, number words, and Roman numerals were selected for each student. The sets were matched on stimulus characteristics, and counterbalanced across two conditions, referred to as future and nonfuture. Each student in the dyad had unique stimuli.

The future condition involved (a) direct instruction with a 3-second constant time delay procedure in naming sets and presentation of the corresponding numeral as instructive feedback for correct responses until the student demonstrated criterion level responding on sets, (b) direct instruction with a 3-second constant time delay procedure in naming the numerals (corresponding to the sets previously taught) and presentation of the corresponding number word as instructive feedback for correct responses until the student demonstrated criterion level responding on naming numerals, and (c) direct instruction with a 3-second constant time delay procedure in reading the number words (corresponding to the numerals previously taught) and presentation of the corresponding Roman numeral as instructive feedback for correct responses on the number word.

The nonfuture condition involved (a) direct instruction using a 3-second constant time delay procedure in naming sets, (b) after establishing criterion level performance, direct instruction with a 3-second constant time delay procedure in naming the corresponding numerals, and (c) after establishing criterion level performance, direct instruction with a 3-second constant time delay procedure in reading the corresponding number words. The two conditions were identical with the exception of the presentation of the future targeted behaviors during the consequent events for correct responses in the future condition (i.e., the use of instructive feedback).

Response definitions and recording procedures. The following response definitions were used during experimental conditions: (a) correct anticipations - subject correctly orally names the target stimulus within 3 seconds of the task direction (i.e., "What is this?") given by the instructor, (b)correct waits - subject verbally imitates the target stimulus within 3

seconds of the instructor's verbal model, (c) incorrect anticipations - subject says any word other that the correct word within 3 seconds of the task direction, (d) incorrect waits - subject says any word other than the correct word within 3 seconds of the instructor's verbal model, and (e) no response - subject does not respond within 3 seconds of the instructor's verbal model. During probe conditions, possible responses were correct anticipations, incorrect anticipations, and no responses. Possible responses during 0-second delay intervals were correct waits, incorrect waits, and no responses. All five responses were possible during 3-second delay intervals.

Probe procedures. In all probe sessions, the following trial sequence was used: The instructor secured the child's attention by stating, "(Child's name) look." and simultaneously holding up the stimulus card. When the child looked at the card, the teacher presented the task direction ("What is this?"), followed by a 4-second response interval. Correct responses were reinforced with verbal praise on a CRF schedule and appropriate attending to materials was reinforced with verbal praise on a VR3 schedule. Errors and no responses were ignored. A 2- to 5-second intertrial interval followed the consequent event on each trial.

The following probe schedule was used during Probe Condition I: (Day 1) two observational probe sessions, (Day 2) two target probe sessions, and (Day 3) two target probe sessions. Probe Conditions II and III followed the schedule: (Day 1) one target probe session and one observational probe session, (Day 2) one observational probe session and one target probe session, and (Day 3) one target probe session. The following schedule was implemented during Probe Condition IV: (Day 1) three target probe sessions, and (Day 2) one target probe session and two observational probe sessions.

Target probes were conducted by the instructor in a 1:1 instructional arrangement. Target probe sessions consisted of two trials per stimuli for a total of 32 trials per session. Observational probes were conducted identical to target probes, except that they were conducted by the investigator rather than the instructor.

Instructional procedures. A 3-second constant time delay procedure was used to train sets and then numerals followed by number words. One pair of behaviors was instructed with the next pair of behaviors to be trained presented as instructive feedback for correct responses (future condition). The other pair of behaviors was instructed without the presentation of instructive feedback (nonfuture condition). An individual criterion of 100% correct responses with CRF for two days and 100% correct responses with VR3 for two days was employed in each instructional condition.

Instructional sessions consisted of 8 trials per stimuli for each student and 32 trials per session. A 0-second delay interval was utilized during the first two instructional sessions. All subsequent sessions used a 3-second delay interval. The following trial sequence was used for 0-second nonfuture instructional sessions: The teacher secured the child's attention by stating, "(Child's name), look." and simultaneously holding up the stimulus card. After the child looked at the card, the teacher stated the task direction, "What is this?", and immediately presented the controlling prompt (verbal model). After presenting the controlling prompt, a 3-second response interval was provided followed by the

appropriate consequent event and a 2- to 5-second intertrial interval. Correct responses were followed by verbal praise and an "x" on the token card. Incorrect responses and no responses were ignored. In the future instructional sessions, the trial sequence was identical with the exception of the consequent event for correct responses. In addition to verbal praise and an "x" on the token card, the stimulus to be taught in the next set of behaviors with the same response was shown to the child simultaneous to the teacher stating, "You're correct, and this is another (response)." For example, during instruction on numerals, when the student correctly named the numeral "9" the instructor placed an "x" on the token card, turned the stimulus card over to show the number word "nine" and stated, "That's right, and this is another nine."

All sessions following the 0-second delay interval sessions employed a 3-second delay interval. The following trial sequence was used during 3-second instructional sessions: The teacher secured the child's attention by stating, "(Child's name), look." and simultaneously holding up the stimulus card. After the child looked at the card, the teacher stated the task direction, "What is this?", and then provided a 3-second response interval before presenting the controlling prompt. After presenting the controlling prompt, another 3-second response interval was provided followed by the appropriate consequent event and a 2- to 5-second intertrial interval. In the nonfuture instructional sessions, correct responses both before and after the prompt were followed by verbal praise and an "x" on the token card. Incorrect responses and no responses both before and after the prompt were ignored. In the future instructional sessions the trial sequence was identical with the exception of the consequent event for correct responses. In addition to verbal praise and an "x" on the token card, the stimulus to be taught in the next tier with the same response was shown to the child simultaneous to the teacher stating "You're correct, and this another (response)."

Reliability

Dependent measure reliability data were collected by a research associate at least once in each experimental condition and once a week in conditions lasting longer than one week. A point-by-point method of scoring inter-observer agreement was used (number of exact agreements divided by the number of agreements plus disagreements multiplied by 100) to calculate inter-observer agreement percentages. Data were collected on the following teacher behaviors: presenting an attentional cue; ensuring the child's attention was secured; presenting the task direction; waiting the appropriate delay interval; presenting the controlling prompt; providing the appropriate consequent event; and waiting the intertrial interval. Procedural reliability data were also collected and calculated by dividing the number of actual teacher behaviors by the number of planned teacher behaviors and multiplying by 100 (Billingsley, White, & Munson, 1980).

Results

Inter-observer Agreement and Procedural Fidelity

Dependent measure reliability. Inter-observer agreement data were collected in 27% of the probe sessions for each student, 24% of the future sessions and 27% of the nonfuture

sessions for Brian, 21% of both the future and nonfuture sessions for Rebecca, 22% of both the future and nonfuture sessions for Jared, and 20% of the future sessions and 22% of the nonfuture sessions for Kattie. The percent of agreement in each experimental session for each student was 100.

Procedural reliability. Procedural reliability data were collected in 27% of the probe sessions for each student. During instructional sessions, procedural reliability data were collected during 24% of the future sessions and 27% of the nonfuture sessions for Brian, 21% of both the future and nonfuture sessions for Rebecca, 22% of both the future and nonfuture sessions for Jared, and 20% of the future sessions and 22% of the nonfuture sessions for Kattie.

Procedural reliability during all probe sessions for each teacher behavior for all students was 100%. Procedural reliability during instructional sessions for each teacher behavior was 100% with the following exceptions: (a) for the future condition, the percent of correct implementation for presenting the attending cue for Kattie was 99.4 (97-100), for waiting the appropriate delay interval for Kattie was 99.4 (94-100), and for providing the appropriate consequence for Rebecca and Kattie was 94.8 (97-100) and 99.4 (95-100) respectively; and (b) for the nonfuture condition, the percent of correct implementation for presenting the attending cue for Jared was 98.4 (88-100), for securing attention for Jared was 98.9 (88-100), for providing the task direction for Kattie was 99.6 (94-100), and for providing the appropriate consequence for Brian and Kattie was 98.2 (95-100) and 99.6 (94-100), respectively. Across all trials where an error occurred in providing the appropriate consequence, the error was a result of the instructor failing to mark an "x" on the token card.

Effectiveness

The percent of correct responding for all experimental conditions are shown in Figures 1, 2, 3, and 4. All students exhibited 0% correct responding in Probe I. The introduction of constant time delay in both conditions (future and nonfuture) for identifying the number of members in a set resulted in Brian, Rebecca, and Kattie achieving criterion level responding. No procedural modifications were needed for Brian. Two procedural modifications were made with Rebecca. On the ninth instructional session, a match-to-sample specific attending cue was added. The two behaviors for the condition receiving instruction were placed on the table in front of Rebecca. The instructor then showed Rebecca another behavior and asked, "Which one is the same?" This manipulation did not result in a substantial increase in correct anticipations, therefor a second modification was introduced. During this modification, the target stimulus was placed on the table in front of Rebecca. Rebecca was given red chips and told to cover each dot on the stimulus card with a chip. This manipulation resulted in 100% correct anticipations in both conditions (future and nonfuture). After the first session with 100% correct anticipations, the specific attending cue was dropped to ensure that Rebecca was naming the number of members in the target set rather than counting the chips. Two procedural modifications were required for Kattie. A match-to-sample specific attending cue was introduced on the tenth day of instruction. This procedural implementation was identical to that described for Rebecca. Because Kattie was

anticipating correctly on the first trial presentation in the future conditions, differential reinforcement was introduced in both conditions. Correct anticipations received verbal praise and an "x" on the token card, and correct waits received verbal praise. Following this modification, criterion was met in both conditions.

Insert Figures 1, 2, 3, and 4 about here

In the Probe II condition, correct performance for sets was 100% for Brian, Kattie, and Rebecca in both the future and nonfuture conditions. Correct responding in Probe II condition was 100% for both numerals for Brian, 100% for one numeral and 50% for the other numeral for Rebecca, and 100% for one numeral for Kattie. Each of these occurred on the instructive feedback stimuli

Following Probe II, constant time delay was implemented with numerals in two conditions (future and nonfuture). Brian received one review trial for each numeral in the future condition. Criterion was met in the nonfuture condition without any procedural modifications. In the future condition, both Rebecca and Kattie received one review trial for one target behavior and all eight trials for the other target behavior. Both students achieved criterion level performance with modification of instructional procedures.

During Probe III, Brian had 100% correct responding across three probe sessions to one of the two number words presented as instructive feedback. Rebecca had 100% correct responding to one of the two number words presented as instructive feedback during the first probe session, however, she had 0% correct responding in the next two probe sessions. Kattie did not respond correctly to either of the number words presented as instructive feedback.

Students received direct instruction on number words following Probe III. In the future condition, Brian received one review trial for one behavior and all eight trials for the other behavior. He achieved criterion in both conditions without any procedural modifications. Modifications of the instructional procedures were not implemented with Rebecca or Kattie; however, instruction was stopped due to the end of the school year. During Probe IV, Brian responded at 100% correct to all previously taught behaviors. In addition, the percent of correct responding to one of the Roman numerals presented as instructive feedback was 100 across all probe sessions. Rebecca responded at 100% correct to all stimuli previously instructed in the future condition. However, in the nonfuture condition, Rebecca did not have consistent 100% correct responding. Although Rebecca did not have 100% correct responding to either of the Roman numerals presented as instructive feedback, she did respond correctly to some presentations of one of those Roman numerals. In Probe IV, Kattie responded correctly to all previously instructed stimuli in the future condition and a majority of those in the nonfuture condition. She did not respond correctly to any of the future or nonfuture Roman numerals.

Efficiency

As noted previously, one of the primary objectives of this study was to evaluate the effects of instructive feedback on the efficiency of learning. In Table 2, data are presented on the number of trials, number of errors, and percent of errors through all instructional sessions for each behavior pair for both the future and nonfuture conditions.

Insert Table 2 about here

During instruction on sets, differences in the number of trials through criterion were equivalent for Brian, Rebecca, and Kattie with the future condition requiring twelve trials more than the nonfuture condition. Differences in the number and percent of errors across the two conditions (future and nonfuture) were slight for Brian, Rebecca, and Kattie.

Difference between the future and nonfuture condition during numeral instruction result in the future condition requiring 84 fewer trials for Brian, 31 fewer trials for Rebecca, and 176 fewer trials for Kattie than the nonfuture condition. Differences in the number and percent of errors are not as great for Brian and Rebecca. Brian had no errors in both conditions and Rebecca had no in the future condition and only 2 errors in the nonfuture condition. However, Kattie had 1.1% errors in the future condition and 7.3% errors in the nonfuture condition.

Brian was the only student who met criterion in both conditions during number word instruction. Rebecca did not meet criterion in the nonfuture condition; however, she did respond correctly to these stimuli during the final probe. Therefore, her data are presented and discussed in terms of efficiency. In terms of trials through criterion, less trials were required in the future condition for both Brian and Rebecca, 77 and 12 respectively. Differences in terms of the number and percent of errors through criterion result in the future condition requiring slightly fewer errors for both Brian and Rebecca. Kattie did not reach criterion in the nonfuture condition and did not respond correctly with consistency across the nonfuture stimuli in the final probe. However, it can be noted that the future condition met criterion, while the nonfuture condition did not. Also, the future condition had 20 errors (6.9%) and the nonfuture condition had 25 errors (8.9%).

In terms of teacher time required to instruct behaviors, Dyad A (Brian and Rebecca) received 395 minutes and 42 seconds of direct instruction and acquired 14 behaviors during the future condition. This results in a mean of 28 minutes and 15 seconds of teacher time necessary to teach each behavior. The nonfuture condition received 374 minutes and 25 seconds of direct instruction with 10 behaviors acquired with a mean of 37 minutes and 27 seconds of direct instruction per behavior. For Group A, the instruction through criterion of future condition behaviors required only 76% of the direct instruction time required for the nonfuture condition behaviors.

For Dyad B (Jared and Kattie), the future condition received 220 minutes and 47

seconds of direct instruction and acquired 8 behaviors. In contrast, the nonfuture condition received 258 minutes and 36 seconds of direct instruction and acquired only 4 behaviors. Therefore, the future condition required a mean of 27 minutes and 35 seconds for each behavior and the nonfuture condition required a mean of 64 minutes and 39 seconds for each behavior. For Group B, the instruction through criterion of future condition behaviors required only 42% of the direct instruction time required for the nonfuture condition behaviors.

Observational Learning

During each probe condition, students were assessed on expressive naming of the other dyad members' target and instructive feedback behaviors. Observational sets, numerals, number words and Roman numerals were assessed in two probe sessions during each of the four Probe conditions. Because students moved at an individual pace, students did not have opportunities to observe their peers receiving instruction on all behaviors. Brian saw Rebecca being instructed on sets and numerals and the number words presented as instructive feedback (i.e. number words from the future condition). During Probe I, Brian responded correctly to one of the sets of geometric figures from the future condition. In Probe II, he had acquired (i.e., 100% correct responding to all trial presentations of a behavior) all the sets which were instructed to his peer and all the future numerals presented as instructive feedback. His Probe III performance was identical to his performance in Probe II. In Probe IV, he maintained his performance in Probe III and acquired both nonfuture numerals taught to his peer.

Rebecca saw Brian being instructed on all behaviors in both the future and nonfuture conditions. During Probe I, Rebecca did not respond correctly to any of her peer's target behaviors. In Probe II, Probe III, and Probe IV she acquired and maintained acquisition level performance for all numerals from both the future and nonfuture conditions. The percent of correct responding to all other behaviors remained at O.

Kattie saw Jared receiving instruction on naming number of members in sets of geometric figures, and the presentation of numerals from the future condition. In Probe I, her percent of correct responding to all observational behaviors was 0. In Probe II, she acquired one each of the future and nonfuture sets of geometric figures. In addition, she acquired both of the numerals which she observed being shown to her peer as instructive feedback. The percent of correct responding to all other behaviors was 0. Performance in Probe III and Probe IV was identical to that of Probe II.

Results for Jared

Jared received instruction only on naming the number of members in sets of geometric figures. In Probe I he had 0% correct responding to all target behaviors across all conditions. He met criterion in the future condition and then received review trials; however, he did not meet criterion in the nonfuture condition. Several modifications of procedure were introduced in the nonfuture condition: (a) match-to-sample; (b) differential reinforcement; (c) increase in back-up reinforcer; and (d) an additional instructional session

each day. In addition to these planned procedural modifications, several other "modifications" were introduced. Following the eighteenth day of instruction, Jared was absent for one week. Upon his return, it was decided by his intervention team that he would attend the preschool on only Monday, Wednesday, and Friday morning.

In terms of efficiency, we can report the number of trials, number of errors, and percent of errors for the sessions in which he received instruction. These measures are presented in Table 2. We cannot compare the efficiency of the two procedures "accurately" because the study was terminated due to the end of the school year before criterion was reached in the nonfuture condition.

Jared observed his peer being instructed on all her target behaviors. In Probe I, he had 0% correct responding to all observational behaviors. During Probe II, he exhibited 100% correct responding to all numerals from both the future and nonfuture conditions. Correct responding to all other behaviors was 0%.

Discussion

This study assessed the effects of presenting instructive feedback for current target behaviors when teaching children four stimulus variations. Based on the results, several findings are discussed. First, the presentation of instructive feedback in the future condition did not interfere with acquisition of target behaviors. This is similar to findings of previous research (Holcombe et al., 1992; Wolery, Doyle, et al., 1991). With naming numerals and naming number words, the future condition required fewer trials and percent of errors than the nonfuture condition.

Second, constant time delay resulted in three of the four students learning to name the numerical value of sets of geometric figures, the corresponding numeral, and the corresponding number word. For the fourth student, Jared, the procedure was effective in the acquisition of naming the numerical value of sets of geometric figures in the future condition. Jared exhibited noncompliant and inappropriate behaviors throughout training which interfered with instruction. He was removed from four instructional sessions as a result of tantrums. As stated earlier, several procedural modifications were made, none of which were successful in Jared's achieving criterion level performance. He continued to respond inconsistently to the nonfuture behaviors in spite of the modifications.

Third, teacher direct instruction time required was greater for the nonfuture condition. Nonfuture instruction resulted in 21 additional minutes and the acquisition of 4 less behaviors for Group A, and 38 additional minutes and the acquisition of 4 less behaviors in Group B. For Group A, four future behaviors were taught in approximately the same amount of time as three nonfuture behaviors. For Group B, seven future behaviors were taught in approximately the same amount of time required of three nonfuture behaviors. Thus, the future condition resulted in more behaviors being learned in less instructional time. When the number of behaviors acquired across all subjects are summed and divided by the total number of minutes of instruction per condition, the future condition resulted in a mean of 28 minutes of instruction per behavior, and the nonfuture condition resulted in 47 minutes of

instruction per behavior. Therefore, the future condition required about 59.6% of the time required of the nonfuture condition to establish criterion on a single behavior. Thus, for every 10 hours of instruction, one would expect 21 behaviors to be acquired in the future condition, and nearly 13 behaviors to be acquired in the non-future condition. These data seem to suggest that there are substantial savings of instructional time by using instructive feedback for behaviors and subjects similar to those taught in this investigation.

Fourth, the addition of the instructive feedback in the consequent event resulted in more rapid acquisition (trials through criterion) of those behaviors when they were subsequently instructed. Future behaviors required 77% of the trials required of nonfuture behaviors.

In furthering this line of research, three issues are worthy of discussion. First, similar research should be conducted with different populations and varying tasks. The effects of instructive feedback on future instruction has been investigated with elementary students when naming photographs and the and naming the corresponding word for the object depicted in the photograph (Wolery, Doyle, et al., 1991); preschool students when naming numerals and the corresponding number words (Holcombe et al., 1992); and preschool students when naming the numerical value of sets of geometric figures, and the corresponding numerals, number words, and Roman numerals. The effects of this research should by investigated across a larger variety of students and skills.

Second, previous research (Holcombe et al., 1992; Wolery, Doyle, et al., 1991) in this area as well as the present study have presented in instructive feedback information in a static format. The instructive feedback information was presented in black ink on white index cards across all trials. In addition, Holcombe et al. (1992) and this study presented the instructive feedback in the same format as the target information. It remains to be investigated whether varying the presentation of the instructive feedback from that of the target behaviors, or varying the presentation of the instructive feedback across trials would result in greater acquisition of those behaviors by the target student or his peers. Also, varying schedules of presenting the instructive feedback should be evaluated. In this study, the instructive feedback was presented on each trial in which the student gave a correct response. An intermittent schedule of instructive feedback presentation may result in differential acquisition rates of that information as compared to a continuous schedule of instructive feedback presentation.

Finally, in these studies the "future" target stimuli presented through instructive feedback were related to the target behavior (i.e. required the same response). Research should evaluate whether instructive feedback will increase the rapidity of future learning when that feedback has a different response from the target behavior. For example, during instruction on word reading, instructive feedback would provide the sequence of the letters in the target word. Such a study would allow for instruction on two different responses (i.e., the word name and the spelling of the word).

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Table 1

Student Demographics and Target Behaviors by Instructional Condition

Dyad Child	CA[a]	Disability	Developmental Ages							Target Behavior[d]	
			SC[b]	AD[b]	MT[b]	CM[b]	CG[b]	EL[c]	RL[c]	Future	Nonfuture
Dyad I											
Brian	60	Developmental/ Language Delay	44	44	54	34	51	39	54	6,10	4,8
Rebecca	44	Seizure Disorder/ Developmental Delay	27	24	28	30	26	30	30	3,7	5,9
Dyad II											
Jared	57	Attention Deficit Disorder/ Developmental Delay	51	41	52	44	51	41	45	4,8	6,10
Kattie	58	Developmental/ Language Delay	50	37	38	47	41	41	46	5,9	3,7

[a] CA = Chronological Age.

[b] Developmental Age scores in these domains derived from the Batelle Developmental Inventory (Newborg, Stock, Wneck, Guidubaldi, & Svinicki, 1984). SC = Social, AD = Adaptive, MT = Motor, CM = Communication, CG = Cognitive.

[c] Developmental Age scores in these domains derived from the Preschool Language Scale (Zimmerman, Steiner, & Pond, 1979). RL = Receptive Language, EL = Expressive Language.

[d] The stimuli for the study were sets of geometric shapes, corresponding numerals, corresponding number words and corresponding Roman numerals.

Table 2

Number of Trials, Number of Errors and Percent of Errors by Student and Condition

Student Behaviors	Number of trials		Number of errors		Percent of errors	
Condition[a]:	F	NF	F	NF	F	NF
Brian						
Sets	384	372	4	1	1.0	0.3
Numerals	12	96	0	0	0.0	0.0
Words	99	176	5	7	5.1	4.0
Total	495	644	9	8	1.8	1.2
Rebecca						
Sets	768	756	51	48	6.6	6.3
Numerals	117	148	0	2	0.0	1.4
Words	116	128	2	4	1.7	3.1
Total	1,001	1,032	53	54	5.3	5.2
Jared						
Sets	401	875	16	105	4.0	12.0
Kattie						
Sets	368	356	11	7	3.0	2.0
Numerals	192	368	2	27	1.1	7.3
Words	288	288	20	25	6.9	8.9
Total	848	1,012	33	59	3.9	5.8
Grand Total	2,745	3,563	111	226	4.0	6.3

[a] F = Future condition, NF = Nonfuture condition.

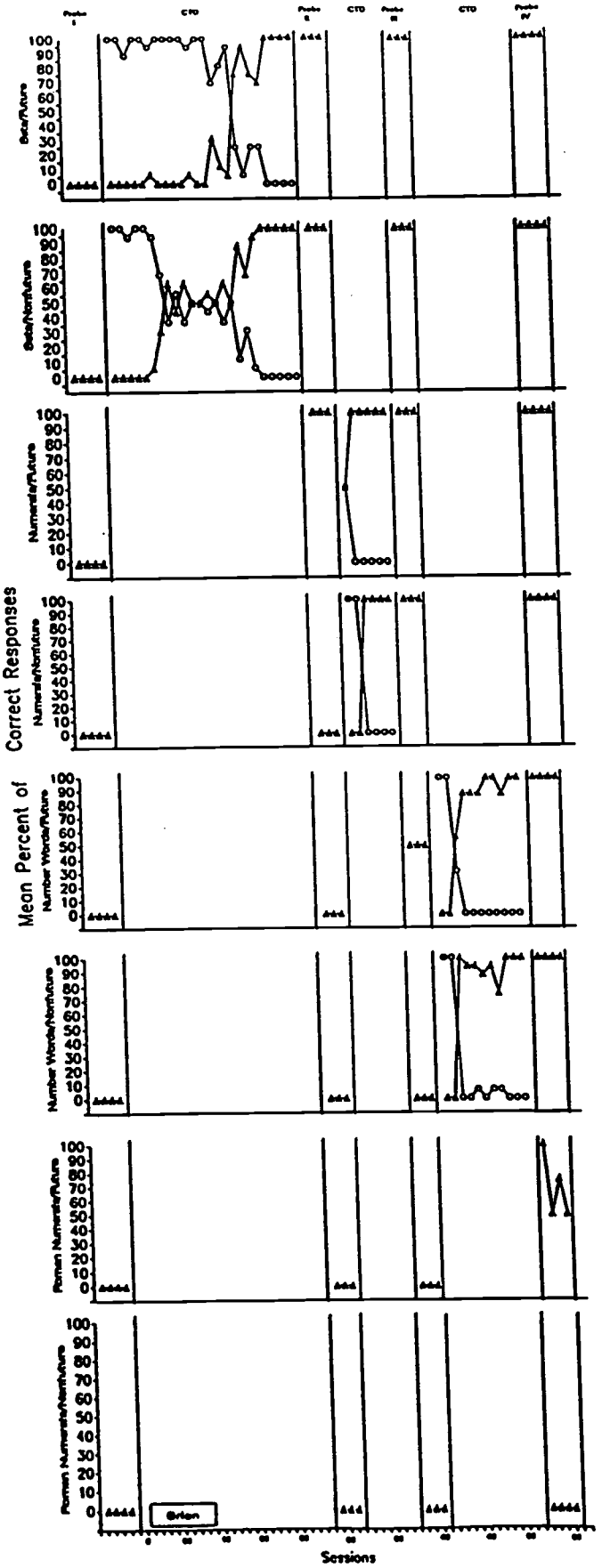
Figure Captions

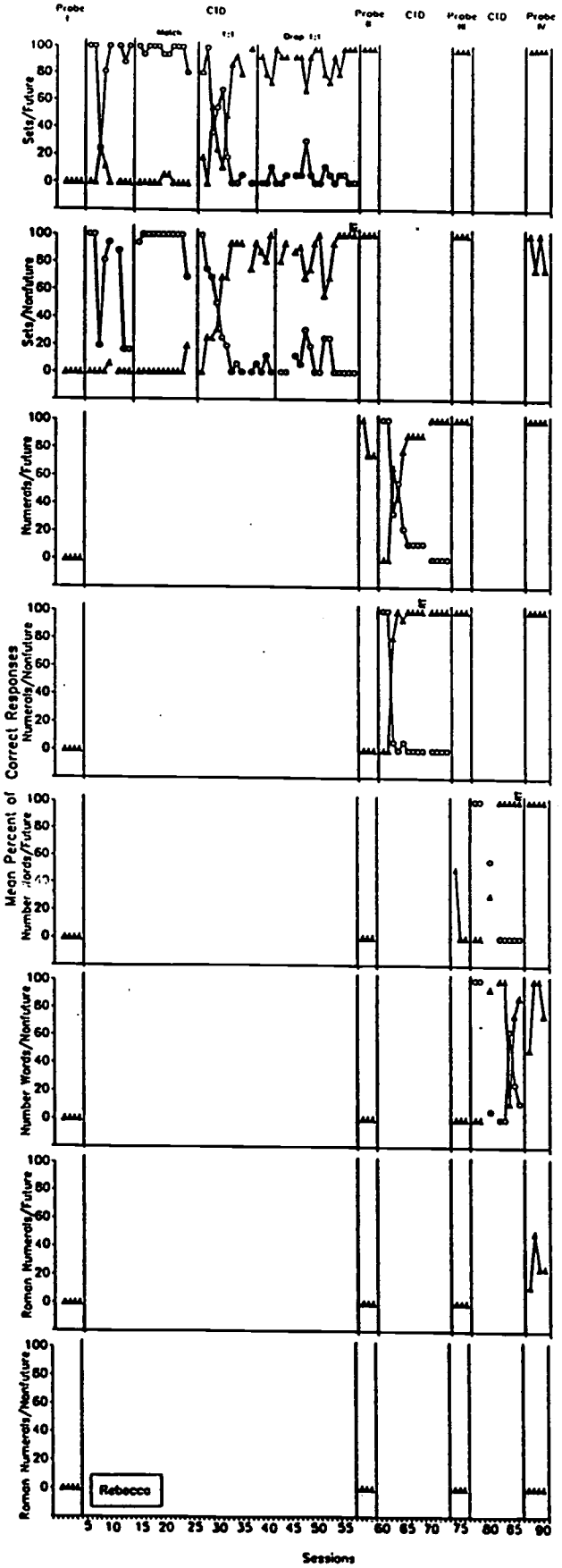
Figure 1. The percent of correct unprompted responses (closed triangles) and the percent of correct prompted responses (open circles) by Brian during probe and instructional conditions.

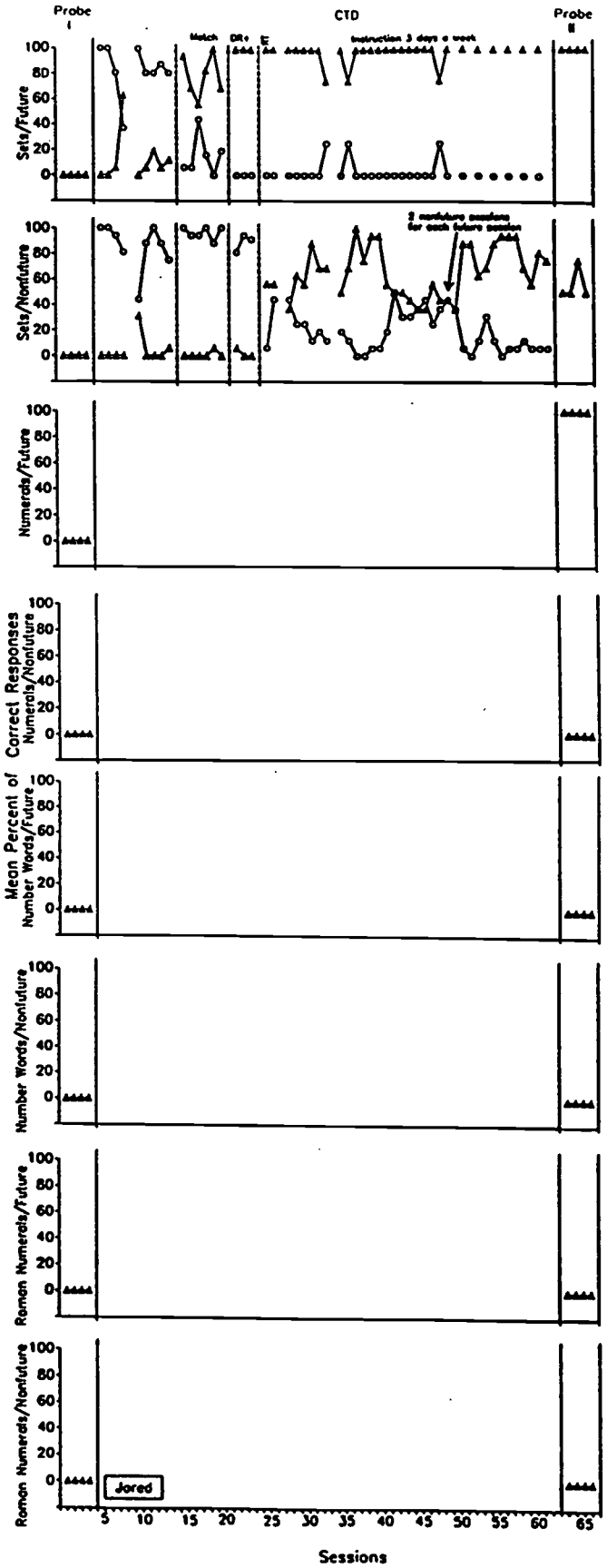
Figure 2. The percent of correct unprompted responses (closed triangles) and the percent of correct prompted responses (open circles) by Rebecca during probe and instructional conditions.

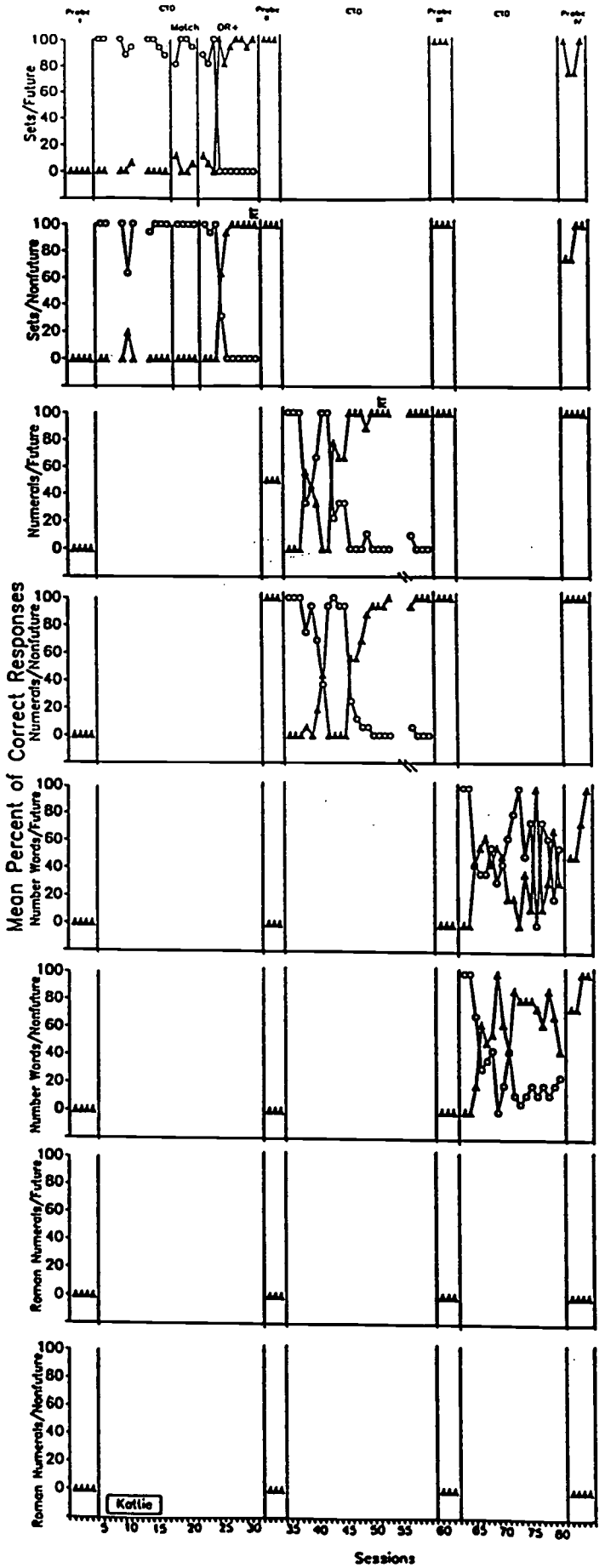
Figure 3. The percent of correct unprompted responses (closed triangles) and the percent of correct prompted responses (open circles) by Jared during probe and instructional conditions.

Figure 4. The percent of correct unprompted responses (closed triangles) and the percent of correct prompted responses (open circles) by Kattie during probe and instructional conditions.









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